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SPECIFICATION FOR ELASTOMERIC INSULATION AND SHEATH OF ELECTRIC CABLES

(First Revision)

Third Reprint AUGUST 1998

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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AMENDMENT NO. 1 MAY 2002
TO
IS 6380 : 1984 SPECIFICATION FOR ELASTOMERIC INSULATION AND SHEATH OF ELECTRIC CABLES

(First Revision)

[*Page* 8, *Table* 3, *Sl No*..(iii)(a), *col* 2 *to* 8] — Substitute the following for the existing entries under various columns:

	(2)	(3)	(4)	(5)	(6)	(7)	(8)
a) Treatment	temperature (tolerance ± 1°C)	°C	—	—	127	127	—
	duration	h	—	—	40	40	—
	pressure (tolerance ± 0.02 MPa	MPa	—	—	0.55	0.55	—

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(First Revision)

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Indian Standard

SPECIFICATION FOR ELASTOMERIC INSULATION AND SHEATH OF ELECTRIC CABLES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 21 August 1984, after the draft finalized by the Power Cables Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard was originally published in 1971 with a view to bringing under a single cover the various requirements of elastomeric insulation and sheath of different types of cables.

0.3 This revision has been undertaken to update it in the light of further experience and developments and to align with international practice, where appropriate. Details about methods of test have been, by and large, taken out from this standard and are now covered in a separate standard, reference to which has been made at appropriate places.

0.4 This standard is complementary to the individual specifications for different types of cables.

0.5 In preparing this standard, assistance has been derived from IEC Pub 502 (1983) ' Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV ', issued by the International Electrotechnical Commission and BS 6899 : 1976 ' Rubber insulation and sheath of electric cables ', issued by the British Standards Institution.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies the physical and electrical requirements for elastomeric insulation and sheath of electric cables.

1.2 The types of insulation and sheath included in this standard are given in Table 1.

TABLE 1 TYPES OF ELASTOMERIC INSULATION AND SHEATH

SL No.	TYPE OF INSULATION/ SHEATH	TYPE REFERENCE	MAXIMUM RATED OPERATING TEMPERATURE OF CONDUCTOR
(1)	(2)	(3)	(4)
i)	Insulation for general service	IE 1	60°C
ii)	Heat resisting insulation:		
	a) suitable for voltages up to 1 100 V	IE 2	90°C
	b) suitable for voltages above 1 100 V	IE 3	90°C
	c) oil resisting and flame retardant insulation suitable for voltages up to 1 100 V	IE 4	90°C
iii)	Silicon rubber insulation	IE 5	150°C
iv)	Sheath for general service:		
	a) normal duty	SE 1	60°C
	b) heavy duty	SE 2	60°C
v)	Heat resisting, oil resisting and flame retardant elastomeric sheath:		
	a) normal duty	SE 3	90°C
	b) heavy duty	SE 4	90°C
vi)	Silicon rubber sheath	SE 5	150°C

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definition in addition to those given in IS : 1885 (Part 32)-1971* shall apply.

2.1 Variation — Difference between the median value obtained after treatment and the median value obtained without treatment, expressed as a percentage of the latter.

---

*Electrotechnical vocabulary: Part 32 Cables, conductors and accessories for electricity supply.

3. COMPOSITION

3.1 Insulation and Sheath for General Service (IE 1, SE 1 and SE 2) — It shall consist of an elastomeric compound in which the characteristic constituent is a natural or synthetic elastomer, or a mixture of the two.

3.2 Heat Resisting Insulation (IE 2 and IE 3) — It shall consist of an elastomeric compound based on synthetic rubber (ethylene propylenes rubber or polyalkane rubber of ethylyene propylene type or similar polymer).

3.3 Oil Resisting and Flame Retardant Insulation (IE 4) — It shall consist of an elastomeric compound based on chlorosulphonated polyethylene or equivalent.

3.4 Heat Resisting Sheath (SE 3 and SE 4) — It shall consist of an elastomeric compound in which the characteristic constituent shall be either polychloroprene, chlorosulphonated polyethylene or NBR-PVC blends or other suitable synthetic rubber.

3.5 Silicon Rubber Insulation and Sheath (IE 5 and SE 5) — It shall consist of an elastomeric compound in which the characteristic constituent is silicon rubber.

4. TEST REQUIREMENTS

4.1 The insulation and sheath shall meet the test requirements stated in Tables 2 and 3, respectively to the extent specified in the related cable specification.

TABLE 2 TEST REQUIREMENTS FOR ELASTOMERIC INSULATION

(*Clause* 4.1)

Sl No.	Test	Unit	Type References					Method of Tests, Ref to Part of IS : 10810*
			IE 1	IE2	IE 3	IE 4	IE5	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Insulation resistance constant, *Min*:							
	a) at 27°C (*see* Note)	MΩkm	700	3 670	3 670	10	870	43
	b) at maximum rated temperature (*see* Table 1)	MΩkm	†	3·67	3·67	—	—	
ii)	Without ageing:							
	a) Tensile strength, *Min*	N/mm^2	5·0	4·2	4·2	7·0	5·0	7
	b) Elongation at break, *Min*	percent	250	200	200	200	150	
iii)	After ageing in air oven:							
	a) Treatment { temperature (tolerance ±2°C)	°C	70	135	135	135	200	11
	duration	days	10	7	7	7	10	
	b) Tensile strength variation, *Max*	percent	±40	±30	±30	±50	±20	
	c) Elongaion at break, variation, *Max*	percent	±40	±30	±30	±50	±20	
iv)	After ageing in air bomb:							
	a) Treatment { temperature (tolerance ±1°C)	°C	—	127	127	127	—	‡
	duration	hours	—	40	40	40	—	
	pressure (tolerance ±0·02 MPa)	MPa	—	0·55	0·55	0·55	—	
	b) Tensile strength, variation, *Max*	percent	—	±30	±30	±50	—	
	c) Elongation at break, variation, *Max*	percent	—	±30	±30	±50	—	
v)	After ageing in oxygen bomb:							
	a) Treatment { temperature (tolerance ±1°C)	°C	70	—	—	—	—	‡
	duration	hours	96	—	—	—	—	
	pressure (tolerance ±0·07 MPa)	MPa	2·1	—	—	—	—	
	b) Tensile strength, variation, *Max*	percent	±25	—	—	—	—	
	c) Elongation at break, variation, *Max*	percent	±35	—	—	—	—	

vi) **Oil resistance test:**							
a) Treatment { oil temperature (tolerance ±2°C)	°C	—	—	—	100	—	31
duration	hours	—	—	—	24	—	
b) Tensile strength, variation, *Max*	percent	—	—	—	±40	—	
c) Elongation, variation, *Max*	percent	—	—	—	±40	—	
vii) **Ozone resistance:**							
a) Ozone concentration (by volume)	percent	—	—	0·025 to 0·030	—	—	13
b) Test duration	hours	—	—	30	—	—	
c) Visual examination	—	—	—	free from cracks	—	—	
viii) **Water absorption (electrical):**							
a) Average stress	V/mm	—	800	3 200	800§	—	28
b) Increase in capacitance, *Max*							
1) 1 to 14 days	percent	—	10	6	15§	—	
2) 7 to 14 days	percent	—	3	2·5	5§	—	
ix) **Hot set test:**							
a) Treatment { temperature (tolerance ±3°C)	°C	—	250	250	200	—	30
mechanical stress	N/cm^2	—	20	20	20	—	
b) Hot set elongation, *Max*	percent	—	175	175	175	—	
c) Permanent set, *Max*	percent	—	15	15	15	—	

NOTE — Insulation resistance test may be done at room temperature instead of 27°C. However, in case of doubt or dispute, the test results shall be confirmed by testing at 27°C.

---

*Methods of test for cables.

†Value under consideration.

‡Under preparation. In the meantime test method given in Appendix A shall be followed.

§Applicable only if the cable is to be operated in wet location.

TABLE 3 PHYSICAL TEST REQUIREMENTS FOR ELASTOMERIC SHEATH

(*Clause* 4.1)

SL No.	TEST	UNIT	TYPE REFERENCES					METHOD OF TESTS, REF TO PART OF IS : 10810*
			SE 1	SE 2	SE 3	SE 4	SE 5	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	**Without ageing:**							
	a) Tensile strength, *Min*	N/mm^2	7·0	14·0	8·0	11·0	5·0	7†
	b) Tensile stress at 200 percent elongation, *Min*	N/mm^2	—	—	—	4·0	—	
	c) Elongation at break, *Min*	percent	300	300	250	250	150	
ii)	**After ageing in air oven:**							
	a) Treatment { temperature (tolerance ±2°C)	°C	70	70	—	—	200	11
	duration	days	10	10	—	—	10	
	b) Tensile strength, variation, *Max*	percent	±20	±20	—	—	±20	
	c) Elongation variation, *Max*	percent	±20	±20	—	—	±20	
iii)	**After ageing in air bomb:**							
	a) Treatment { temperature (tolerance ±1°C)	°C	—	—	127	127	—	‡
	duration	hours	—	—	40	40	—	
	b) Tensile strength variation, *Max*	percent	—	—	±50	±50	—	
	c) Elongation variation, *Max*	percent	—	—	±50	±50	—	
iv)	**Oil resistance test:**							
	a) Treatment { oil temperature (tolerance ±2°C)	°C	—	—	100	100	—	31
	duration	hours	—	—	24	24	—	
	b) Tensile strength, variation, *Max*	percent	—	—	±40	±40	—	
	c) Elongation variation, *Max*	percent	—	—	±40	±40	—	
v)	Tear resistance, *Min*	N/mm	—	5·0	—	5·0	—	17§

vi) **Hot set test:**

a) Treatment { temperature (tolerance ±3°C)	°C	—	—	200	200	—	30
mechanical stress	N/cm^2	—	—	20	20	—	
b) Hot set elongation, *Max*	percent	—	—	175	175	—	
c) Permanent set, *Max*	percent	—	—	15	15	—	

---

*Methods of test for cables.

†Tensile stress at 200 percent elongation shall be noted for type SE 4 during the test for tensile strength and elongation at break.

‡Under preparation. In the meantime test method given in Appendix A shall be followed.

§Under preparation. In the meantime test method given in Appendix B shall be followed.

APPENDIX A

[*Table* 2, *Sl No.* (iv) *and* (v), and *Table* 3, *Sl No.* (iii)]

AGEING IN AIR BOMB AND OXYGEN BOMB

A-1. These tests shall be carried out, generally, in accordance with IS : 10810 (Part 11)-1984* with the exception that in place of ageing oven, a suitable pressure chamber (bomb) shall be used. Test specimens shall be placed in the chamber without touching each other and they shall not occupy more than one-tenth of the effective capacity of the chamber. Specimens from compounds of substantially different compositions shall not be tested at the same time.

A-2. In case of air bomb test, the chamber shall be filled with air, free from oil and moisture, to the specified pressure.

A-3. In case of oxygen bomb test, the chamber shall be filled with commercial oxygen of not less than 97 percent purity, to the specified pressure.

A-4. The test specimens shall be kept in the chamber at the specified temperature for the specified period.

A-5. As soon as the ageing period is completed, the pressure shall be released gradually, so as to reach atmospheric pressure in not less than 5 minutes, in order to avoid formation of pores in the test specimens.

A-6. Test specimens shall then, be removed from the chamber and left at ambient temperature, avoiding direct sunlight, for at least 16 hours.

A-7. Test for tensile strength and elongation at break, shall then be carried out and the variations calculated.

APPENDIX B

[*Table* 2, *Sl No.* (v)]

TEAR RESISTANCE

B-1. TEST SPECIMEN

B-1.1 The test specimen shall be prepared from a piece of sheath of the cable taken not less than 300 mm from the end of the cable. The specimen shall have dimensions as shown in Fig. 1. The sheath shall be cut open length wise and the other components of the sheathed cable which are not to be part of this test specimen shall be removed carefully without causing damage to the sheath. It is permissible to grind the sheath to remove irregularities or corrugations if present, before preparing the specimen.

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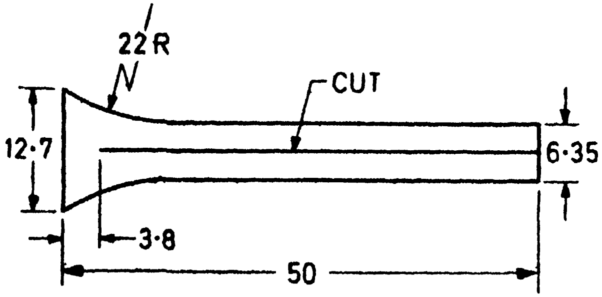
*Methods of test for Cables: Part 11 Thermal ageing in air.



All dimensions in millimetres.

FIG. 1. TEST SPECIMEN FOR TEAR TEST

B-1.2 A central longitudinal cut, perpendicular to the width of test specimen is made to a point 3·8 mm from the wider end. The thickness of test specimen shall be not greater than 4·0 mm, nor less than 1·0 mm.

B-1.3 Number of test specimens shall be six.

B-2. CONDITIONING

B-2.1 All the test specimens shall be kept at a temperature of 27 ± 2°C for a period of not less than 3 hours prior to testing.

B-3. PROCEDURE

B-3.1 The test shall be made within 5 minutes of removing the specimen from the conditioning cabinet. The halves of the split end of the test specimens shall be placed in the jaws of a tensile testing machine and the jaws separated at the rate of 350 to 500 mm per minute till the test specimens rupture. Tear resistance shall be determined by dividing the maximum load by thickness of the test specimen. The results are classified in order of increasing value and the average of the two middle values is taken as the tear resistance.

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